

CLAIMS

What is claimed is:

- 1 1. A method comprising:
- 2 separating a random number generator into a first
- 3 stage and second stage;
- 4 replicating the circuitry of said second stage into M
- 5 parallel modules; and
- 6 generating M random number outputs using a single
- 7 first stage circuitry and M parallel second stage modules.
- 1 2. A method according to claim 1 wherein each of
- 2 said M modules have a first input which is the output
- 3 result of said single first stage circuitry and second
- 4 input, which is the unique to the module.
- 1 3. A method according to claim 2 wherein said first
- 2 stage circuitry has at least two first stage inputs, a
- 3 first first stage input representing the integer coordinate
- 4 components of the location of interest and a second first
- 5 stage input representing the hardware cycle.

1 4. A method according to claim 3 wherein generating
2 includes:

3 storing said first stage inputs in a first register;
4 selecting a first set of bits from said first
5 register;

6 storing said first set of bits in a second register;
7 and

8 selecting a second set of bits from said second
9 register, said second set of bits representing said result
10 of said single first stage circuitry.

1 5. A method according to claim 4 wherein for each
2 parallel second stage module, generating further includes:

3 storing said result of said single stage circuitry in
4 a second stage register; and

5 selecting a second set of bits from said second stage
6 register, said second set of bits representing one of said
7 M random number outputs.

1 6. A method according to claim 5 wherein said each
2 random number output can be one of a phase 1 output and a
3 phase 2 output.

1 7. A method according to claim 6 wherein said phase 2
2 output is a full and exact representation of the desired
3 random number output.

1 8. A method according to claim 7 wherein said phase
2 1 output is an approximation of said phase 2 output.

1 9. A method according to claim 4 wherein selecting
2 said first set of bits includes:
3 utilizing a group of XORs, each XOR having its inputs
4 pre-wired to various locations of said first register, to
5 select among the bits of said inputs.

1 10. A method according to claim 4 wherein selecting
2 said second set of bits includes:
3 utilizing a group of XORs, each XOR having its inputs
4 pre-wired to various locations of said second register, to
5 select among the bits stored therein.

1 11. A method according to claim 5 wherein said
2 selecting in each parallel second stage module includes:

3 utilizing a group of XORs, each XOR having its inputs
4 wired to a number of bits representing the module number
5 and to selected locations of said second stage register.

1 12. A method according to claim 11 wherein the wired
2 number of bits representing the module number varies from
3 XOR to XOR.

1 13. A method according to claim 11 wherein each
2 parallel second stage module wires its XORs to its
3 registers in an identical manner with all other parallel
4 second stage modules.

1 14. A method of generating a noise function output at
2 a first location comprising:

3 generating M random number outputs, each random number
4 output representing a pulse, using a single first stage and
5 M parallel second stage circuitries;

6 determining the relevance of each random number output
7 to said noise function output; and

8 accumulating each of an effective weighting computed
9 for each relevant random number output.

1 15. A method according to claim 14 wherein generating
2 includes:

3 storing said first stage inputs in a first register;
4 selecting a first set of bits from said first
5 register;

6 storing said first set of bits in a second register;
7 and

8 selecting a second set of bits from said second
9 register, said second set of bits representing said result
10 of said single first stage circuitry.

1 16. A method according to claim 15 wherein generating,
2 for each parallel second stage module, further includes:

3 storing said result of said single stage circuitry in
4 a second stage register; and

5 selecting a second set of bits from said second stage
6 register, said second set of bits representing one of said
7 M random number outputs.

1 17. A method according to claim 16 wherein said each
2 random number output can be one of a phase 1 output and a
3 phase 2 output.

1 18. A method according to claim 17 wherein said phase
2 2 output is a full and exact representation of the desired
3 random number output.

1 19. A method according to claim 18 wherein said phase
2 1 output is an approximation of said phase 2 output.

1 20. A method according to claim 15 wherein selecting
2 said first set of bits includes:
3 utilizing a group of XORs, each XOR having its inputs
4 pre-wired to various locations of said first register, to
5 select among the bits of said inputs.

1 21. A method according to claim 15 wherein selecting
2 said second set of bits includes:
3 utilizing a group of XORs, each XOR having its inputs
4 pre-wired to various locations of said second register, to
5 select among the bits stored therein.

1 22. A method according to claim 16 wherein said
2 selecting in each parallel second stage module includes:

3 utilizing a group of XORs, each XOR having its inputs
4 wired to a number of bits representing the module number
5 and to selected locations of said second stage register.

1 23. A method according to claim 19 wherein
2 determining the relevance includes:

3 testing phase 1 outputs to see if the pulses they
4 represent fall approximately within an area of interest
5 about said first location; and

6 updating a queue with a positive indication for each
7 pulse that falls within said area.

1 24. A method according to claim 23 wherein said area
2 of interest is determined by a circle swept by a radius
3 about said first location.

1 25. A method according to claim 24 wherein testing
2 includes:

3 determining the distance between the location of a
4 pulse as approximated by their phase 1 output and said
5 first location;

6 subtracting an allowable difference from said
7 determined distance; and

8 comparing the result of said subtraction with said
9 radius.

1 26. A method according to claim 25 wherein if said
2 result is not greater than said radius, then said pulse is
3 determined to fall approximately within said area of
4 interest.

1 27. A method according to claim 19 wherein
2 accumulating includes:
3 fetching the full phase 2 output for each pulse
4 determined to be relevant to said noise function output;
5 determining what effect each said relevant pulse would
6 have to said noise function;
7 modifying by said effect the weight of said pulse
8 given by said phase 2 output, said modification yielding an
9 effective weight; and
10 summing together effective weights for all pulses
11 deemed to be relevant to said noise function output, said
12 sum representing the amplitude of the noise function at
13 said first location.

1 28. A method according to claim 27 wherein
2 determining what effect includes:

3 computing a sum of squared differences between said
4 pulse as represented by its phase 2 output and said
5 location;
6 correlating said sum of squared differences with a
7 corresponding effect factor; and
8 obtaining said effect factor from a filter table.

1 29. A method according to claim 28 wherein modifying
2 includes:
3 multiplying said effect factor by said weight.

1 30. An apparatus configured to generate M random
2 number outputs on a given cycle j in a parallel fashion,
3 comprising:
4 a first stage circuitry configured to accept a series
5 of inputs; and
6 M second stage modules, the output of said first stage
7 wired as an input each of said M modules, the output of
8 each module one of said M random number outputs.

1 31. An apparatus according to claim 30 wherein said
2 series of inputs includes the cycle number j, the number of
3 dimensions desired and integer coordinate components for
4 each dimension desired.

1 32. An apparatus according to claim 30 wherein each
2 said second stage module also includes an input k
3 representing the number of the module.

1 33. An apparatus according to claim 31 each said
2 random number output contains a fractional coordinate
3 component for each desired dimension as well as a weight of
4 the corresponding pulse at the location given said
5 fractional coordinate components and said integer
6 coordinate components.

1 34. An apparatus according to claim 30 wherein said
2 first stage circuitry comprises:
3 a first register having locations storing each bit of
4 said series of inputs; and
5 a first bank of XORs, each input of each said XOR of
6 said first bank coupled to an arbitrary one of said
7 locations of said first register.

1 35. An apparatus according to claim 34 wherein said
2 first stage circuitry further comprises:
3 a second register having locations storing each output
4 of said first bank of XORs; and

5 a second bank of XORs, each input of said XORs of said
6 second bank coupled to an arbitrary one of said locations
7 of said second register, each output of said second bank of
8 XORs representing each bit of said output of said second
9 stage.

1 36. An apparatus according to claim 32 wherein each
2 second stage module comprises:

3 a first register having locations configured to store
4 each bit of said output of said first stage; and

5 a bank of XORs having one set of inputs from said
6 first register and a second set of inputs from the bits of
7 input k, the output of each XOR representing one bit of
8 said random number output.

1 37. An apparatus according to claim 36 wherein said M
2 second stage modules produce an approximation of the full
3 said random number output.

1 38. An apparatus for generating a noise function
2 output, said noise function output a combination of
3 relevant pulses, comprising:

4 a random number generator configured to generate M
5 random number outputs in a parallel fashion, each of said M

6 outputs an approximation of a full version of each of said
7 random number outputs;
8 a chooser device coupled to said random number
9 generator, said chooser determining if the pulse
10 represented by each said random number output is relevant
11 to the noise function;
12 a queue coupled to said chooser device, said queue
13 storing which of said M random number outputs were
14 determined relevant, said apparatus configured to generate
15 the full version of the relevant random number outputs;
16 an effect generator coupled to said queue, said effect
17 generator modifying the weight of each pulse as given by
18 said full version according to the location of the pulse
19 represented by said full version;
20 and an accumulation device coupled to said effect
21 generator to accumulate said effect modified pulses
22 weights, the result of said accumulation the amplitude of
23 the noise function.